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Analysis of the Need Response to the Development of the E - Module of Parabolic Motion Material at SMA Bengkulu City

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Abstract

The problem that students often face in their learning is a misunderstanding in studying physics. The reason is because educators only teach physics abstractly through the classroom, without laboratory experiments (practice) or the use of other media aids, such as using ICT-based learning media. The research method used by researchers is research and development (R&D). R&D is a research model for the purpose of producing products and product feasibility tests. This research was conducted through five different stages of the ADDIE development model. Development, implementation and evaluation are not carried out because the purpose of this study is only to develop modules. This module is not directly applicable to classroom learning. The population used in the study was 153 students and 4 physics teachers from 3 high schools in Bengkulu City. The results of the needs analysis are valid and reliable, teachers and students of 3 high schools in Bengkulu City strongly agree with the development of E-modules for parabolic motion materials.

Keywords: Critical Thinking, Development Research, E-module, Parabolic Motion, Video Tracker.

A. Introduction

In the 21st century, science and technology have made important great progress. As science and technology advance, the educational community must be able to prepare in advance [1]. In the 21st century, science and technology have made important major advances. As science and technology advance, the educational community must be able to prepare in advance [2].

A common problem that students face in their studies is misunderstandings while studying physics. The reason is because educators only teach abstract physics Through classes, reducing the process of experimentation in the laboratory (practice) or using other media aids, such as using ICT-based learning media (Information and Communication) [3]. Achieving a level of learning quality is an important goal that teachers can achieve by using media sources to enter learning activities. One of the goals is to increase students' understanding and enthusiasm for learning. Therefore, as a teacher, it is important to be able to select, optimize and combine interesting and varied learning elements and media that allow students to engage with the material well. For example, some of the learning media that teachers can use are printed, module, or technology-based books such as animated videos, E-interactive package modules, and audiovisual media [4].

Modules are learning materials that allow students to learn independently. Learning modules are prepared based on the principles of module development which include needs analysis, module design development, implementation, evaluation, assessment and validation, and quality assurance. With the help of modules, students can learn in a more controlled and systematic way. Students know how to manage the skills needed for further study [5]. Among students, modules are mostly printed modules, which are more informative, simple pictorial, and contain only practical questions. Among students, the modules are mostly printed modules, which are more informative, simple pictorial, and contain only practical questions [6]. In addition, there are some colleges that implement stand-alone textbooks or electronic modules (E-modules) because they are more widely known. Not much different from textbooks, electronic modules are also planned systematically and according to the curriculum. More independent electronic modules mean that students can learn through electronic modules without having to meet face-to-face with the teacher [7].

Electronic modules or E-modules are the latest innovations of simple modules, so these electronic modules can be accessed by computers whose built-in software supports the use of E-modules. The advantages of emodules compared to print modules are interactive, easy to navigate, display or download images, audio,

video and animation, and come with formative tests that provide automatic feedback directly [8]. In this process, educational success cannot be separated from the curriculum. The curriculum we are currently using is the 2013 curriculum which requires students to develop various skills such as communication skills, critical thinking and creative thinking. Therefore, students must be trained in critical thinking, creativity, communication and collaboration which is often called 4C (critical thinking and problem solving, creativity, communication and collaboration) [9]. In addition, critical thinking is indispensable in the 21st century . According to the class X Physics teacher of SMAN 06 Bengkulu City, critical thinking skills are one of the most important skills to be developed.

One of the subjects that can encourage students to think critically is physics [10]. Physics is a subject that is closely related to students' daily lives. One of the learning of physics skills in the issue of Permendikbud no. 6 of 2013, namely. Develop critical thinking while studying physics [11]. The results of Sahbana's 2012 research [12] show that students' critical thinking ability on parabolic motion material is caused by the dominance of the studentcentered learning process which makes students passive. Students' critical thinking skills are relatively weak with an average of only about 68, and the category is quite 0-100 points. The results of the study [13] claim that if learning is still learning from teachers and the media, there will be no change in teacher use. Therefore, students do not understand the concepts of physics, feel bored and apathetic in studying physics so that the learning results are not satisfactory.

One of the phenomena of motion in physics that is often encountered in everyday life is parabolic motion. Parabolic motion is one of the most important materials in high school physics. With traditional learning methods, learning materials that track the motion of objects are not enough. The nature of abstract matter cannot be done by direct observation, so other learning devices are needed to visualize parabolic motion. Based on interviews and observations of researchers, it was also revealed that current print learning media such as textbooks and modules are used when learning physics in the classroom [14]. According to a physics teacher in grades 10 and 11 of SMAN 01 Bengkulu City, teaching parabolic motion material to students is quite difficult because there is no media to help teachers in explaining the material to students. This opinion is in line with the opinion of class X and XI physics teachers of SMAN 01 Bengkulu City who stated that the difficulty in teaching parabolic motion material to students was due to the lack of available teaching aids.

The importance of parabolic motion experiments is in understanding the various concepts of parabolic motion. Information about the position of an object in time can provide information about the maximum height and the maximum distance it can transport. One method that can be used is to analyze parabolic motion video with a video tracker [15]. . Non-laboratory experimental activities can be carried out using Tracker Video Analysis (TVA), which is an open source application and free to use. TVA tracks the movement of objects based on video frames imported into the application. Therefore, the movement of the analyzed object must be recorded first before it can be analyzed with TVA and searched for relationships between the desired variables [16].

Based on the results of observations and interviews with physics teachers at 3 SMA Bengkulu City for the 2021/2022 academic year, the same problem was found, namely that teachers still use conventional methods during learning activities, indeed. has not utilized the role of learning media as a means of learning for students, therefore many students are less active and rely a lot on teacher interpretation, or commonly called teacher learning. The teaching and learning process focuses on the teacher as the mediator of the material, while the student as the passive recipient. The fact that student learning is not paid attention to causes students not to enthusiastically participate in the teaching and learning process. In addition, teachers only use textbooks and PowerPoint to deliver material in class as teaching materials. So that it affects student activities and tends to be passive and not interested in participating in learning activities.

Based on some of the problems above, it is necessary to conduct a study to analyze the need for the development of video tracking E-modules of parabolic motion material to improve critical thinking at Bengkulu City High School.

B. Research Methods

The research method of the researchers is research and development (R and D). Research and Development (R and D) is a form of research that aims to produce products and test manufacturability. The product that will be produced in the research and feasibility test is an electronic module assisted by video tracking that can be used in learning parabolic motion materials at a junior high school in Bengkulu City. The electronic module in question is a computer interactive module that students can access via the internet. The model

used in this study refers to the ADDIE model. The study applies five different stages of the ADDIE development model. Development, implementation and evaluation are not carried out because the purpose of this study is only to develop modules. This module is not directly applied to classroom learning.

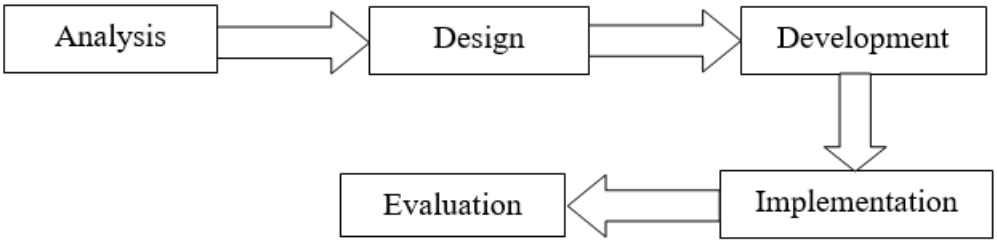

Figure 1. ADDIE model development steps [17].

This research was conducted at 3 high schools in Bengkulu City, namely SMAN 01 Bengkulu City, SMAN 06 Bengkulu City and SMAN 07 Bengkulu City. The research period was conducted in June-August 2022 in Bengkulu City. The sample is the representative part of the population that the researcher is concerned about. A good sample is one that has important characteristics similar to the entire population and also represents the population well [18]. This study used a sampling technique, namely purposive sampling, namely as needed, so that the sample could represent the characteristics of the general population [19] with a sample of 153 class X science students and S1 students. 5 physics teachers Observation, interviews and questionnaires were used for data collection. With this research questionnaire, students need to develop parabolic motion e-module material. This needs analysis uses student surveys of their needs for parabolic motion e-module material as a research tool, and needs analysis surveys are distributed online and offline. Online in the form of Google Forms, Offline Print for Class X Science High School Students. The data analysis of this study is quantitative. It is called quantitative data because the data obtained in digital form comes from the Likert scale in table 1.

Table 1. Likert Scale Calculation [20]

Information	Value
Strongly Agree (SS)	4
Agree (S)	3
Disagree (TS)	2
strongly disagree (STS)	1

The decision of each questionnaire item obtained in this study is based on research decisions conducted by Eko Risdianto [21]

Reliable : if the r_{count} is greater than the r_{table} value ($r_{count} > r_{table}$)
Non-reliable : if the r_{count} is smaller than the r_{table} value ($r_{count} < r_{table}$)
Then to calculate the percentage of answers to the student questionnaire using research conducted by [9]

$$\%X_{in} = \frac{\Sigma s}{S_{maks}} \text{ x } 100\% \quad (1)$$

$\%X_{in}$ = Percentage of statement answer score on E-module questionnaire
$\sum s$ = Number of answer scores
S_{maks} = Maximum score

The questionnaire is used as an analysis of the distributed data and the results are collected. The data is then processed (reduced) so that it can be used as a survey response. In addition, the results of data processing of indicators are classified according to Riduwa, 2015 [22] in an interpretation scale to calculate the results in the form of a table in percentage terms as useful information obtained from the study as in table 2

Table 2. Scale of Interpretation [22]

Persentase	Category
0-25%	strongly disagree (STS)

Persentase	Category
26-50%	Disagree (TS)
51-75%	Agree (S)
76-100%	Strongly Agree (SS)

C. Result and Discussion

Student response results

Based on the results of the questionnaire analysis, students contain the first indicator, namely No e-module with a percentage seen in the 1st statement diagram of 49.02% strongly agree (SS), 44.44% agree (S) for the statement " I always use the package book in the process of learning physics" and on the diagram of the 2nd statement as much as 21.57% strongly agree (SS), 64.71% agreed (S) for the statement "I do not have an electronic book in the process of learning parabolic motion".

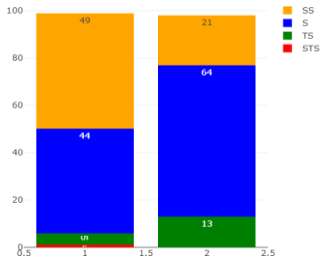

Figure 2. response diagram has e-module

Based on figure 2, it shows the results that students still do not have an E-module of parabolic motion material and there are still many students who only learn with package books. This is in accordance with research (Erlina et al., 2022) that as many as 58% of students still only use package books when learning physics and as many as 88.3% of students do not have electrical modules when learning physics.

Furthermore, the learning indicators are still teacher-centered with percentages seen in the 3rd statement chart as much as 46.41% strongly agree (SS) and 53.59% agree (S) to the statement " I get the subject matter more often from the teacher". In the 4th statement diagram 24.18% strongly agreed (SS), 54.25% agreed (S) for the statement " I have not played an active enough role in the physics learning process" and the 5th statement diagram as many as 33.33% strongly agree (SS), 58.17% agree (S), for the statement "I need teaching materials that can be accessed online".

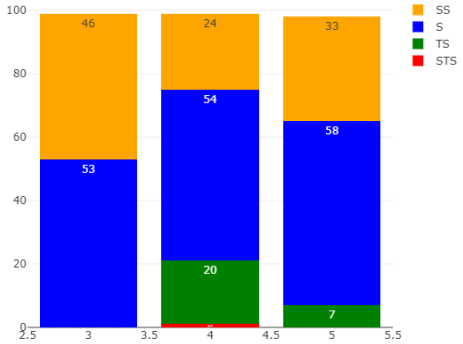

Figure 3. Current learning student response diagram

Based on figure 3 above, it can be seen that when learning physics, students still get subject matter only from teachers more often so that learning is still not optimal and there are still many students who are not active in physics learning. This is also revealed by [23] students' active learning in physics subjects is still not optimal and students agree and need online teaching materials that can make it easier for students to learn anywhere and anytime.

The 3rd indicator is the attractive display of e-modules with a percentage of statement diagram 6 of 50.33% strongly agree (SS), 45.10% agree (S) for the statement "The learning resource I want is the one with the image according to the material". In the 7th statement chart 41.18% strongly agreed (SS), 54.90% agreed (S) for the statement "the learning resources I like are those that have an interesting cover". In the 8th statement chart 39.87% strongly agreed (SS), 52.29% agreed (S) for the statement "the learning resource I

want is one that has the appropriate color mix" and on statement chart 9 47.71% strongly agree (SS), 49.67% agree (S) for the statement "the learning resource I need is to use simple language"

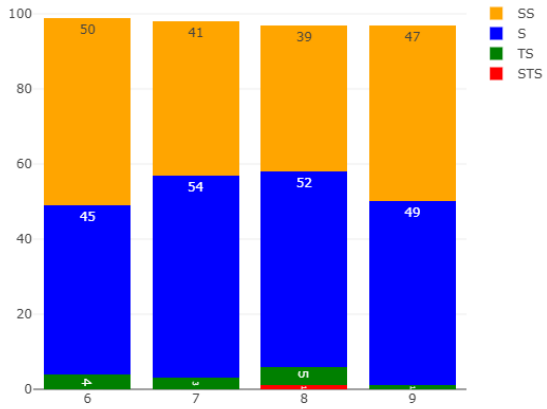

Figure 4. Diagram of students' response to the attractive E-module display

From the 4th figure shows the result that during learning students want an attractive E-module display when learning physics. This is in accordance with research [24] that as many as 78% of students need interesting worksheets.

Then in an interesting learning resource, of course, it is equipped with various traits that are also explained in the fifth indicator, namely having e-module supporting attributes with a percentage of statement diagram 10 as much as 50.33% strongly agree (SS), 45.75% agree (S) for the statement "I want teaching materials that have instructions for use so that it makes it easier for me in learning activities". In the diagram of statement 11 as many as 43.14% strongly agree (SS), 53.59% agree (S) for the statement "I want a learning medium that can help understand parabolic motion material". On the diagram of statement 12 as many as 39.22% strongly agree (SS), 56.86% agree (S) for the statement "I want a learning medium that can analyze changes in the position of a moving object" and statement diagram 13 as many as 43.79% strongly agree (SS), 54.90% agree (S) for the statement "I like the systematically arranged teaching materials, neat and directed specific to the material.".

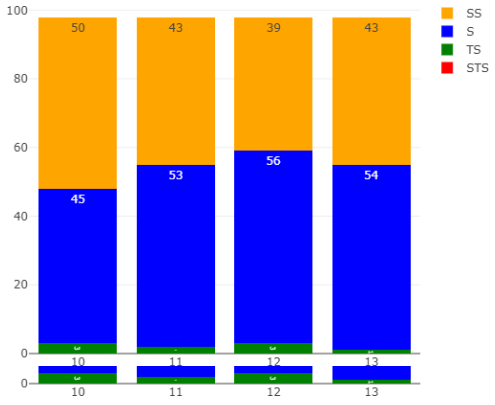

Figure 5. Diagram of student response to e-module supporting attributes

From the diagram above it is obtained that students want the supporting attribute of E- module. This e-module has several advantages, including: (1) E-module is built on the steps of the PjBL learning model; (2) Increase the attractiveness of student involvement in learning; (3) Provide opportunities for students to solve situational problems; (4) Students can understand the learning material independently [25].

The 5th indicator is to use the latest and interesting learning media with a percentage of 14 statement diagrams of 37.91% strongly agree (SS), 54.25% agree (S) for the statement " the learning resource I want is the one that has interactive videos in it and can be played online or in person". On the diagram of statement 15 35.95% strongly agree (SS), 58.82% agree (S) for the statement "the learning resources I want

are the ones that can be flipped back and forth like a manual". In the diagram of statement 16 as many as 43.79% strongly agree (SS), 50.98% agree (S) for the statement "the learning resources I want are the ones I can access anywhere". In the diagram of statement 17 as many as 47.06% strongly agree (SS), 50.33% agree (S) for the statement "the learning resources I want are those that have various materials or other teaching materials that support the learning material". In the diagram of statement 18 as many as 43.79% strongly agree (SS), 52.94% agree (S) for the statement "the learning resources I want are those that can be used indefinitely". In the diagram of statement 19 as many as 47.06% strongly agree (SS), 47.06% agree (S) for the statement "the learning resources I want are those that can be accessed at any time via mobile phone". In the diagram of statement 20 as many as 44.44% strongly agree (SS), 51.63% agree (S) for the statement "the learning resources I want are those that have a new and interesting look".

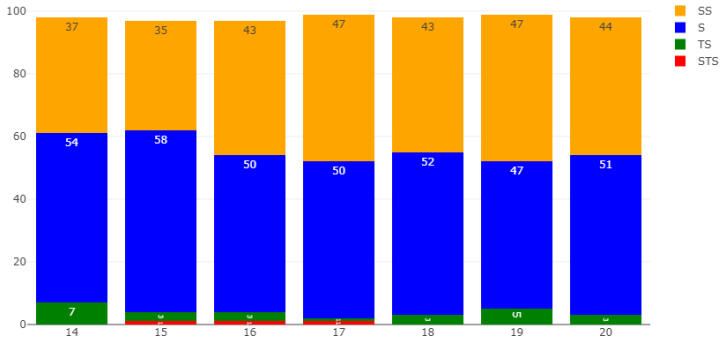

Figure 6. Diagram of students' responses to the latest and interesting learning media

From the percentage diagram above, it is known that students agree to use the latest and interesting learning media. Therefore, the media that will be used by researchers is the latest software today, namely video trackers. Tracker is a free video modeling and analysis tool built on the Java Open Source Physics (OSP) framework. Tracking video modeling is a powerful way to combine video with computer modeling [26].

The 6th indicator contains critical thinking skills with the percentage on the 21st statement chart as much as 48.37% strongly agree (SS), 49.02% agree (S) for the statement "I need teaching materials that can provide a simple explanation". In the diagram of statement 22 as many as 50.33% strongly agree (SS), 47.06% agree (S) for the statement "I need teaching materials that can build my basic skills and abilities". In the diagram of statement 23 as many as 47.71% strongly agree (SS), 49.02% agree (S) for the statement "I need teaching materials that can draw conclusions correctly and well". In the diagram of statement 24 47.06% strongly agree (SS), 50.33% agree (S), 2.61% disagree (TS) for the statement "I need teaching materials that can provide further explanation". And 25 statement diagrams as many as 52.94% strongly agree (SS), 43.14% agree (S) for the statement "I need teaching materials that can help me in setting strategies and tactics in learning activities".

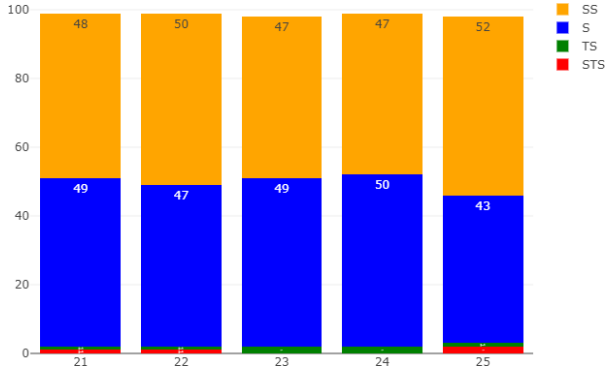

Figure 7. Diagram of students' response to indicators of critical thinking ability

Based on the percentage above, it is known that students agree that the module contains critical thinking skills. The need for critical thinking skills is closely related to dynamic, rapidly changing, and unpredictable world situations. This ability is necessary in analyzing, evaluating, and drawing correct conclusions about

complex problems.ini showing that the ability to think critically is one of the important abilities to be developed from the most basic level of education [27].

To obtain a valid result in the validity test calculation using the r table $\alpha = 0.05$, it can be said that the item is valid according to the following table 3.

Table 3. Item Validity Test Results

Number of Items	**r-Count**	**r-Table**	**Information**
1.	0,338		
3.	0,241		
4.	0,363		
5.	0,483		
6.	0,441		
7.	0,432		
8.	0,473		
9.	0,444		
10.	0,463		
11.	0,472		
12.	0,596		
13.	0,440		
14.	0,596	0,158	Valid
15.	0,531		
16.	0,569		
17.	0,641		
18.	0,559		
19.	0,632		
20.	0,447		
21.	0,566		
22.	0,480		
22.	0,480		
23.	0,485		
24.	0,540		
25.	0,693		

This study used a student needs questionnaire with response options. The evaluation uses a likert scale of the points in the questionnaire, with a maximum score of and a minimum of 1 point. Validity and reliability tests are conducted for the corresponding items mentioned in the questionnaire to find out whether the common tools are valid and reliable. The results of data validity calculation are presented in Table 4

Tabel 4. Case Processing Summary

Cases	Valid	153	100.0
	Excluded[a]	0	.0
	Total	153	100.0

In table 4.case processing summary above it can be seen that there are 153 number of respondents (N) for which 100% of the data is processed and in the exclude data the value is 0 so that no data is issued (exclude).for reliability tests can be seen in table 5

From Table 5. The reliability of the above statistics can be seen from the number of expressions up to 25 items and the value is 0.872 using Cronbach's Alpha method. This value of Cronbach alpha is then

compared with the value of r in Table 3. From the results of the factor validity test, it can be concluded that 0.872 > 0.158, so the data is said to be reliable or trustworthy.

The data of student response rates for each item of the E-module development questionnaire of parabolic motion material can be analyzed by Table 5.

Tabel 5. Results Percentage of Response Data to Students' Needs

Respond	Average score	Highest score	Persentase (P_S%)	Category
153 Class X Students of SMAN Bengkulu City	12894	15300	84,27%	Very agreeable

Table 5. the results of the percentage of data response to student needs received information that students in 3 SMAN Bengkulu City strongly agreed with the development of E-modules on parabolic grak material. This is shown in the percentage in table 6 getting 84.27% of 100% according to Table 2. The scale of interpretation by [22] which states that 81-100% are categorized strongly agrees. This is in accordance with research [28] which states that the need for E-modules gets a percentage of 87%, indicating that students strongly agree and need electronic modules that can help students understand physics materials and can be easily accessed using smartphones or computers to study independently.

Then use excel to crunch the data to find out how many students were selected from the total respondents from strongly agreeing to strongly disagreeing, as shown in the chart below.

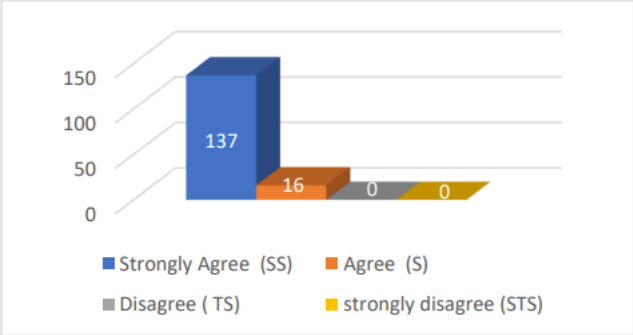

Figure 8. Bar chart of the number of students against category items

The diagram in figure 8 above shows that the total student respondents from 3 Bengkulu City High Schools were 153 students and there were 137 students who strongly agreed and 16 students agreed while for the category of disagreeing and strongly disagreeing consisted of 0 students. So it can be concluded that students in 3 SMAN in Bengkulu city strongly agree with the development of the E-module of parabolic motion material.

In addition to the questionnaire data, researchers also conducted interviews with several physics teachers in 3 high schools in Bengkulu city.

Teacher Interview Results

Based on the results of physics teacher interviews conducted in 3 schools, namely SMAN 01, SMAN 06 and SMAN 07 Bengkulu City, the first indicator is about facilities and infrastructure such as internet and electricity networks, laboratories, study rooms and facilities in schools. The average teacher answers for the internet network in schools only in the teacher's room while for the classroom it is still not affordable so that students still use data packages for learning that uses the internet. For laboratories in each school have been well managed, there are only a few tools that are no longer suitable for use and teachers still often do learning in the classroom rather than outside the classroom by utilizing infocus in accordance with the material to be taught.

The second indicator is the teaching materials used, learning media, learning methods, activities and materials contained in schools. The average teacher answers for the teaching materials used by the teacher are still printed while for non-printed in the form of powerpoints (PPT) according to the material to be taught.for learning media some teachers still use simple media such as doing demos in front of the class and for electronics using powerpoints and videos. The average learning method of teachers using a combination of lecture, discussion and question and answer methods and for student learning interest activities is still not all and all teachers agree that parabolic movement material is difficult to teach.

The last indicator in the interview is the virtues of each school such as being allowed to carry communication tools, sanctions, and study hours. Each school allows students to bring cellphones to school, but they are not used during classroom learning unless the teacher tells students to open cellphones. And for the sanction of each school, there is something in the teacher's room and physics learning every school is two hours of learning twice a week and teachers still feel that it is lacking because in addition to the material, there is also a practicum which is quite time-consuming.

From the results of the interview, the teacher experienced difficulties when teaching parabolic motion material due to the lack of learning media materials so that they could know that students agreed with the development of the E-module of parabolic motion material.

D. Conclusion

Based on the results of the needs analysis conducted for the development of e-modules of parabolic motion materials of 3 SMAN Bengkulu City, it can be concluded that the needs analysis conducted is valid and reliable, and the teachers and students of SMAN Bengkulu City 3 are confident to agree on the development of E-moduli for parabolic motion materials.

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References

[1] N. M. Fuad, S. Zubaidah, S. Mahanal, and E. Suarsini, "Improving junior high schools' critical thinking skills based on test three different models of learning," *Int. J. Instr.*, vol. 10, no. 1, pp. 101–116, 2017, doi: 10.12973/iji.2017.1017a.

[2] P. M. S. Siregar, "Penerapan Media Pembelajaran Geogebra Dengan Dua Kurva," *FORDETAK Semin. Nas. Pendidik. Inov. Pendidik. di Era Soc. 5.0*, pp. 37–43, 2022.

[3] S. Indah, R. Eko, and J. Henny, "Pengembangan Bahan Ajar Elektronik Menggunakan Flip PDF Professional pada Materi Alat-Alat Optik di SMA," *J. Kumparan Fis.*, vol. 2, no. 3, pp. 145–152, 2019, [Online]. Available: file:///C:/Users/HP/Downloads/jurnal/jurnal 3.pdf.

[4] A. M. Kusuma and P. Mahardi, "Analisis Deskriptif Terhadap Pengembangan Media Pembelajaran E – Modul Interaktif Berbasis Software Aplikasi Lectora Inspire," *J. Kaji. Pendidik. Tek. Bangunan (JKPTB).*, vol. 07, no. 02, pp. 1–11, 2021.

[5] A. D. Yasa, "Pengembangan Modul Tematik Berbasis Stm (Sains, Teknologi Dan Masyarakat)," *J. Pemikir. dan Pengemb. Sekol. Dasar*, vol. 6, no. 1, p. 21, 2018, doi: 10.22219/jp2sd.v6i1.5899.

[6] Anggraini Diah Puspitasari, "Penerapan Media Pembelajaran Fisika Menggunakan Modul," *Fis. J. Pendidik.*, vol. 7, no. 1, pp. 17–25, 2019, [Online]. Available: http://journal.uin-alauddin.ac.id/indeks.php/PendidikanFisika.

[7] R. Sidiq, N. Najuah, P. S. Lukitoyo, J. P. Manalu, and Z. Elvansya, "Development Of Interactive E-Module Based On Infographic Multimedia In Islamic History Of Indonesian Courses As An Innovative Learning Source," *Int. J. Educ. Res. Soc. Sci.*, vol. 3, no. 1, pp. 135–139, 2022.

[8] M. Arsal, M. Danial, and Y. Hala, "Pengembangan Media Pembelajaran E-Modul Materi Sistem Peredaran Darah pada Kelas XI MIPA SMAN 6 Barru," *Pros. Semin. Nas. Biol. VI Harmon. Pembelajaran Biol. pada Era Revolusi 4.0*, pp. 434–442, 2019.

[9] R. Erlina, E. Risdianto, R. Efendi, D. Hamdani, I. Fathurrochman, and A. G. Prananosa, "Analisis Respon Kebutuhan Terhadap Pengembangan E-Modul Materi Elastisitas dan Hukum Hooke di

SMA Kabupaten Lebong," *JMKSP (Jurnal Manajemen, Kepemimpinan, dan Supervisi Pendidikan)*, vol. 7, no. 8.5.2017, pp. 2003–2005, 2022.

[10] D. Wahyuni, M. Sari, and Hurriyah, "Efektifitas e-Modul Berbasis Problem Solving Terhadap Keterampilan Berfikir Kritis Perserta Didik," *Nat. Sci. J. Penelit. Bid. IPA dan Pendidik. IPA*, vol. 6, no. 2, pp. 180–189, 2020.

[11] F. S. Ulandari, S. Wahyuni, and R. W. Bachtiar, "Pengembangan Modul Berbasis Saintifik Untuk Melatih Kemampuan Berpikir Kritis Pada Materi Gerak Harmonis Di Sman Balung," *J. Pembelajaran Fis.*, vol. 7, no. 1, p. 15, 2018, doi: 10.19184/jpf.v7i1.7220.

[12] U. Handayani, M. Masykuri, and N. S. Aminah, "Pengembangan Modul Fisika Berbasis Problem Based Learning (PBL) untuk Meningkatkan Keterampilan Berfikir Kritis pada Materi Usaha dan Energi di SMA/MA," *J. Inkuiri*, vol. 6, no. 2, pp. 107–116, 2017, [Online]. Available: https://digilib.uns.ac.id/dokumen/detail/50500/Pengembangan-modul-fisika-berbasis-problem-based-learning-pbl-untuk-meningkatkan-keterampilan-berpikir-kritis-pada-materi-usaha-dan-energi-di-smama.

[13] S. N. Hayati, Hikmawati, and Wahyudi, "Pengaruh Model Pembelajaran Inkuiri dengan Menggunakan Media Simulasi Terhadap Hasil Belajar Fisika Siswa Kelas X MIA SMAN 1 Lingsar Lombok Barat Tahun Pelajaran 2016/2017," *J. Pendidik. Fis. dan Teknol. (ISSN. 2407-6902)*, vol. 3, no. 2, p. hal. 10, 2017.

[14] B. Pradana, S. Sukarmin, and D. T. Rahardjo, "Pengembangan Modul Pembelajaran Fisika Elektronik Berbasis Pendekatan Saintifik pada Materi Gerak Parabola untuk Siswa Kelas X SMA," *J. Mater. dan Pembelajaran Fis.*, vol. 11, no. 2, p. 61, 2021, doi: 10.20961/jmpf.v11i2.48156.

[15] R. Hayyuningtias and Y. Pramudya, "Studi Awal Sonifikasi Pada Data Gerak Parabola Berbantuan Arduino Uno R3 Atmega328," *JIPFRI (Jurnal Inov. Pendidik. Fis. dan Ris. Ilmiah)*, vol. 6, no. 1, pp. 51–59, 2020.

[16] I. A. Rizki, N. F. Citra, H. V. Saphira, W. Setyarsih, and N. P. Putri, "Eksperimen Dan Respon Mahasiswa Terhadap Praktikum Fisika Non-Laboratorium Menggunakan Aplikasi Tracker Video Analysis Untuk Percobaan Kinematika Gerak," *J. Teach. Learn. Phys.*, vol. 6, no. 2, pp. 77–89, 2021, doi: 10.15575/jotalp.v6i2.12640.

[17] L. Iswati, "Developing Addie Model-Based Esp Coursebook," *Indones. EFL J.*, vol. 5, no. 2, p. 103, 2019, doi: 10.25134/ieflj.v5i2.1804.

[18] C. Uakarn, K. Chaokromthong, and N. Sintao, "Sample size estimation using Yamane and Cochran and Krejcie and Morgan and Green formulas and Cohen statistical power analysis by Gpower and comparisons," *Apheit Int. J.*, vol. 10, no. 2, pp. 76–88, 2021.

[19] J. A. Pardede and A. Ramadia, "The Ability to Interact with Schizophrenic Patients through Socialization Group Activity Therapy," *Int. J. Contemp. Med.*, 2021, doi: 10.37506/ijocm.v9i1.2925.

[20] D. Taluke, R. S. M. Lakat, A. Sembel, E. Mangrove, and M. Bahwa, "Analisis Preferensi Masyarakat Dalam Pengelolaan Ekosistem Mangrove Di Pesisir Pantai Kecamatan Loloda Kabupaten Halmahera Barat," *Spasial*, vol. 6, no. 2, pp. 531–540, 2019.

[21] E. Risdianto, M. Yanto, M. Kristiawan, and G. Gunawan, "Respon Guru Pendidikan Anak Usia Dini terhadap MOOCs berbantuan Augmented Reality," *J. Obs. J. Pendidik. Anak Usia Dini*, vol. 5, no. 2, pp. 1487–1500, 2020, doi: 10.31004/obsesi.v5i2.907.

[22] Y. P. Putri and A. G. Adirakasiwi, "Analisis Minat Belajar Siswa Kelas X SMA At-Taubah pada Materi SLPTV dengan Metode Pembelajaran Daring," *J. Cendekia J. Pendidik. Mat.*, vol. 5, no. 3, pp. 2934–2940, 2021, doi: 10.31004/cendekia.v5i3.987.

[23] F. Andriani, A. Harso, and A. S. Rahmawati, "Pembelajaran Fisika Di Sma Negeri 1 Kuwus Golowelu Selama Masa Pandemi Covid-19," *Karst J. Pendidik. Fis. dan Ter.*, vol. 4, no. 2, pp. 91–99, 2021.

[24] D. Vitrianingsih, H. Yuliani, N. I. Syar, and M. Nasir, "Analisis Kebutuhan Pengembangan Lembar Kerja Siswa (Lks) Berbasis Problem Based Learning Pada Materi Elastisitas Dan Hukum Hooke Kelas Xi Di Sma Negeri 1 Palangka Raya," *Karst J. Pendidik. Fis. DAN Ter.*, vol. 4, no. 1, pp. 1–7, 2021, doi: 10.46918/karst.v4i1.981.

[25] U. Mardhiyah, S. Wanabuliandari, and H. S. Bintoro, "Analisis Kemampuan Pemecahan Masalah Matematis Siswa dengan Menerapkan Model PJBL Berbantuan E -modul Lubuk Etnomatematika," *J. Ilmu Sos. dan Pendidik.*, vol. 6, no. 3, pp. 10040–10044, 2022, doi: 10.36312/jisip.v6i3.3342/http.

[26] F. Mukharomah and A. Mutiarani, "Februari 2021 Gerak Harmonik Teredam Untuk Menentukan Koefisien Viskositas Fluida Berbantuan Software Tracker Video," *WaPFi (Wahana Pendidik. Fis.*,

vol. 6, no. 1, 2021.
[27] S. R. Janah, H. Suyitno, and I. Rosyida, "Pentingnya Literasi Matematika dan Berpikir Kritis Matematis dalam Menghadapi Abad ke-21," *Prism. Pros. Semin. Nas. Mat.*, vol. 2, pp. 905–910, 2019, [Online]. Available: https://journal.unnes.ac.id/sju/index.php/prisma/article/view/29305.
[28] A. C. Kartika and A. Purwanto, "Pengembangan E-Modul Berorientasi Model Curious Note Program Untuk Melatihkan Keterampilan Berpikir Kritis," *DIKSAINS J. Ilm. Pendidik. Sains*, vol. 2, pp. 62–73, 2022.